

C4190 Log Data Report

Borehole Information:

| | | | | | |
|-------------------------------------|--------------------|---------------------------------------|---|--------------------------------|-----------------------|
| Borehole: C4190 | | Site: Southwest of C Tank Farm | | | |
| Coordinates (WA State Plane) | | GWL (ft)¹: 273 | GWL Date: 8/6/2003 | | |
| North N/A ³ | East N/A | Drill Date August 2003 | TOC² Elevation N/A | Total Depth (ft) 318 | Type Becker |

Casing Information:

| Casing Type | Stickup (ft) | Outer Diameter (in.) | Inside Diameter (in.) | Thickness (in.) | Top (ft) | Bottom (ft) |
|---|--------------|----------------------|-----------------------|-----------------|----------|-------------|
| Threaded steel | 2.85 | 6 1/4 | 6 | 1/8 | +2.85 | 318 |
| Threaded steel | 2.25 | 9 | 8 | 1/2 | 2.25 | 318 |
| Casing stickup was measured using a steel tape. The logging engineer measured the outside diameters for both the 6- and 8-in. casings using a caliper. The caliper and 6-in. inside casing diameter were measured using a steel tape; measurements were rounded to the nearest 1/16 in. | | | | | | |

Borehole Notes:

Zero reference is the ground surface. This borehole was logged through the drill pipe. The borehole is located approximately 30 ft east of UPR 200-E-86 and 20 ft north of the MO 822 change trailer. A 6-in. layer of crushed gravel is present on the ground surface surrounding the drill site.

The Becker drilling system utilizes a special dual-wall casing string. Air passes through the annular space between the inner and outer casing, and drill cuttings are brought up inside the inner casing. For this well, the casing consisted of a 6-in. ID inner casing with 0.125-in. wall thickness inside an 8-in. ID outer casing with 0.5-in. wall thickness. The inner casing is thicker at casing joints, where wall thickness is 0.406 in. Casing joints are approximately 1 ft long overall and occur at 10-ft intervals.

Logging Equipment Information:

| | |
|--|--|
| Logging System: Gamma 1E | Type: 70% HPGe (34-TP40587A) |
| Calibration Date: 07/2003 | Calibration Reference: GJO-2003-486-TAR |
| Logging Procedure: MAC-HGLP 1.6.5, Rev. 0 | |

Spectral Gamma Logging System (SGLS) Log Run Information:

| Log Run | 1 | 2/Repeat | 3 | | |
|-------------------|---------|----------|---------|--|--|
| Date | 8/07/03 | 8/08/03 | 8/08/03 | | |
| Logging Engineer | Spatz | Spatz | Spatz | | |
| Start Depth (ft) | 319.0 | 147.0 | 114.0 | | |
| Finish Depth (ft) | 115.0 | 115.0 | 0 | | |
| Count Time (sec) | 100 | 100 | 100 | | |

| Log Run | 1 | 2/Repeat | 3 | | |
|--------------------------|--------------------------|--------------------------|---|--|--|
| Live/Real | R | R | R | | |
| Shield (Y/N) | N | N | N | | |
| MSA Interval (ft) | 1.0 | 1.0 | 1.0 | | |
| ft/min | n/a ⁴ | n/a | n/a | | |
| Pre-Verification | AE013CAB | AE014CAB | AE014CAB | | |
| Start File | AE013000 | AE014000 | AE014033 | | |
| Finish File | AE013204 | AE014032 | AE014147 | | |
| Post-Verification | AE013CAA | AE014CAA | AE014CAA | | |
| Depth Return Error (in.) | -2.5 | n/a | -1 | | |
| Comments | No fine-gain adjustment. | No fine-gain adjustment. | Fine-gain adjustment after files -101 and -116. | | |

Logging Operation Notes:

Zero reference was the ground surface, and the borehole was logged through drill pipe.

SGLS data were collected using Gamma 1E. Pre- and post-survey verification measurements employed the Amersham KUT (⁴⁰K, ²³⁸U, and ²³²Th) verifier with serial number 118. Logging was performed with a centralizer installed on the sonde.

Analysis Notes:

| | | | | | |
|-----------------|---------|--------------|---------|-------------------|------------------------|
| Analyst: | Sobczyk | Date: | 8/14/03 | Reference: | GJO-HGLP 1.6.3, Rev. 0 |
|-----------------|---------|--------------|---------|-------------------|------------------------|

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day and compared to the control limits. All of the verification spectra were within the control limits, except for spectrum AE013CAB. This spectrum was slightly above the upper control limit for the 609-keV peak counts per second (cps) value. The peak counts per second at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 0.5 percent higher and 7.0 percent lower at the end of the day. Examinations of spectra indicate that the detector functioned normally during all of the logging runs, and the spectra are accepted.

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. The pre-run verification spectrum was used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G1EJul03.xls). Zero reference was the ground surface. Based on measurements supplied by the logging engineer, the casing configuration was assumed to be a string of 6-in. and 8-in. casings to 319 ft. The casing correction factor was calculated using a combined casing thickness of 5/8 in. This casing thickness is based upon the field measurements. The combined thickness at casing joints is 1.115 in. This thickness results in a significant reduction in gamma activity detection as the detector passes by a casing joint. However, it is not practical to correct individual data points for the effect of casing joints every 10.0 ft. The influence of the thick joints is apparent on the total gamma and ⁴⁰K logs where reduced count rates and concentrations are exhibited at approximately 10-ft depth intervals. Water corrections were applied to the data below 273 ft. SGSLs dead time corrections were not applied because dead time did not exceed 10 percent.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (⁴⁰K, ²³⁸U, and ²³²Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are

included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited higher net counts per second.

Results and Interpretations:

^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected near the ground surface at 2 ft and in the interval from 11 through 13 ft at concentrations ranging from the MDL (0.3 pCi/g) to 0.6 pCi/g. The maximum concentration of ^{137}Cs was measured at 12 ft. ^{137}Cs was also detected at log depths of 65, 130, and 218 ft with concentrations near the MDL.

Logging through the drill pipe used in the construction of this borehole precludes the acquisition of SGLS spectra that consistently have statistically valid photopeaks. The relatively thick casing joints effectively shield the detector from the formation over a 3.0-ft zone at 10.0-ft intervals. Energy levels below 1461 keV are severely attenuated by the drill pipe.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS. The natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs. ^{137}Cs encountered at 130 ft on the original log run did not repeat.

¹ GWL – groundwater level

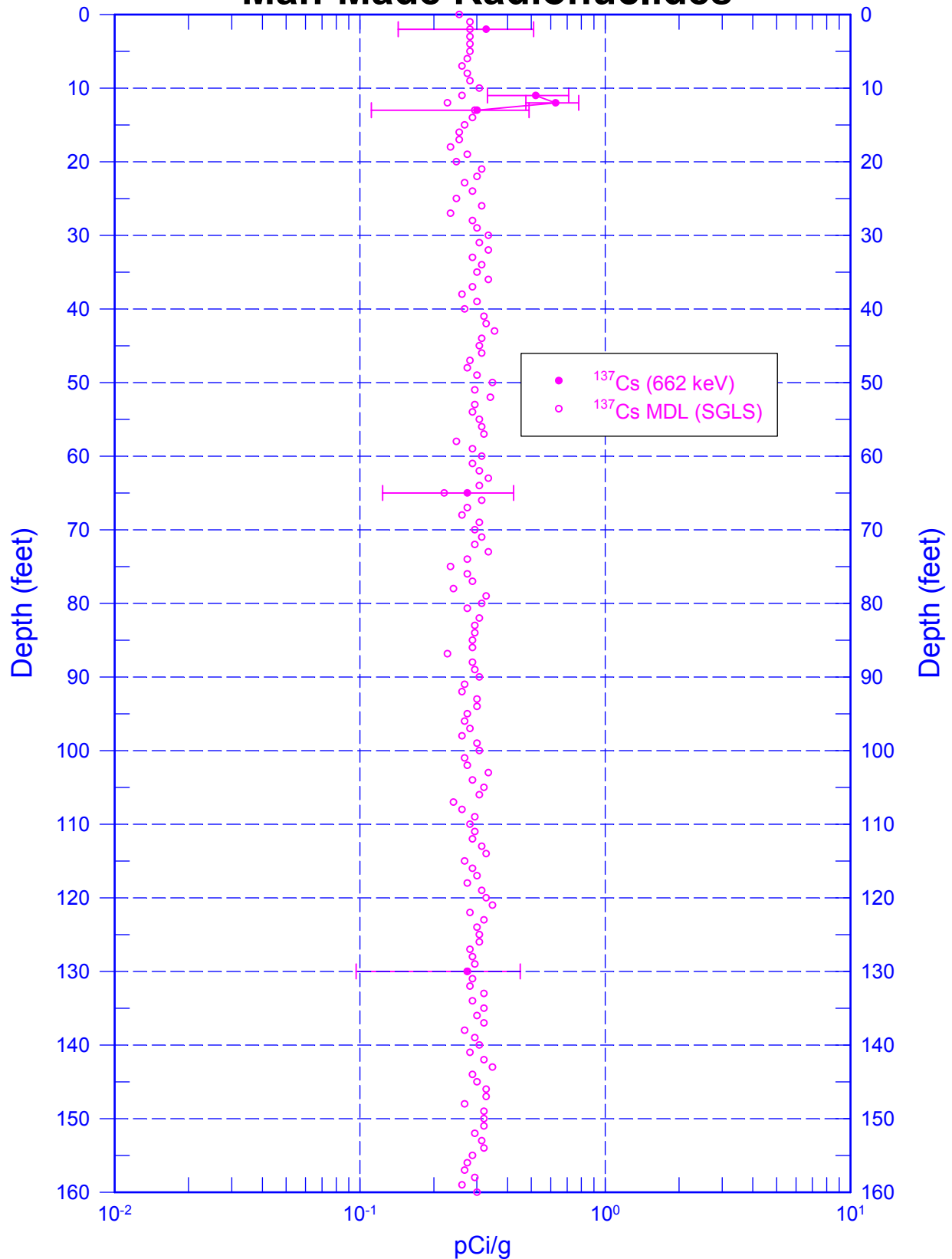
² TOC – top of casing

³ N/A – not available

⁴ n/a – not applicable

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Man-Made Radionuclides

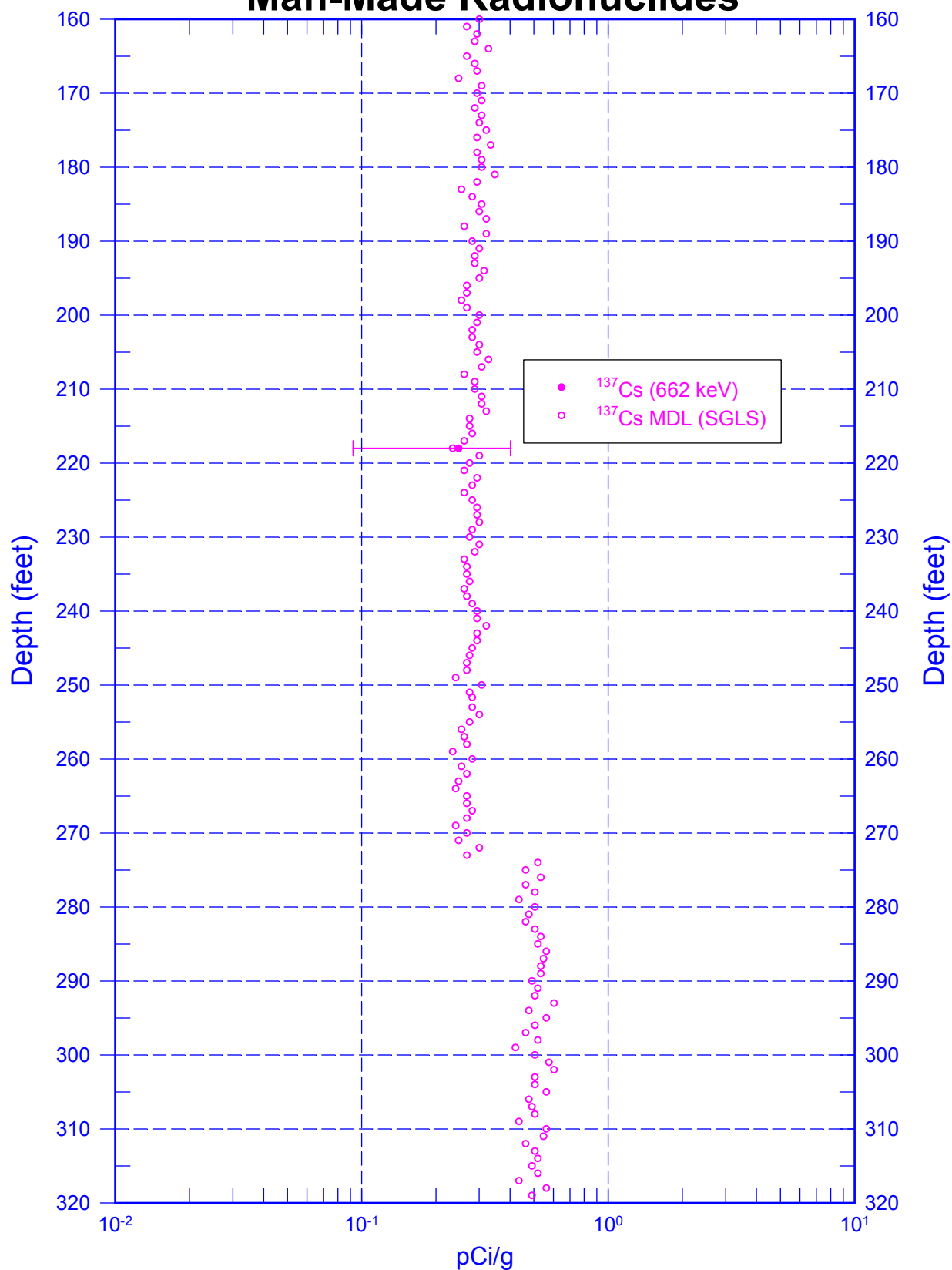


Zero Reference = Ground Surface

Date of Last Logging Run
8/08/2003

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Man-Made Radionuclides

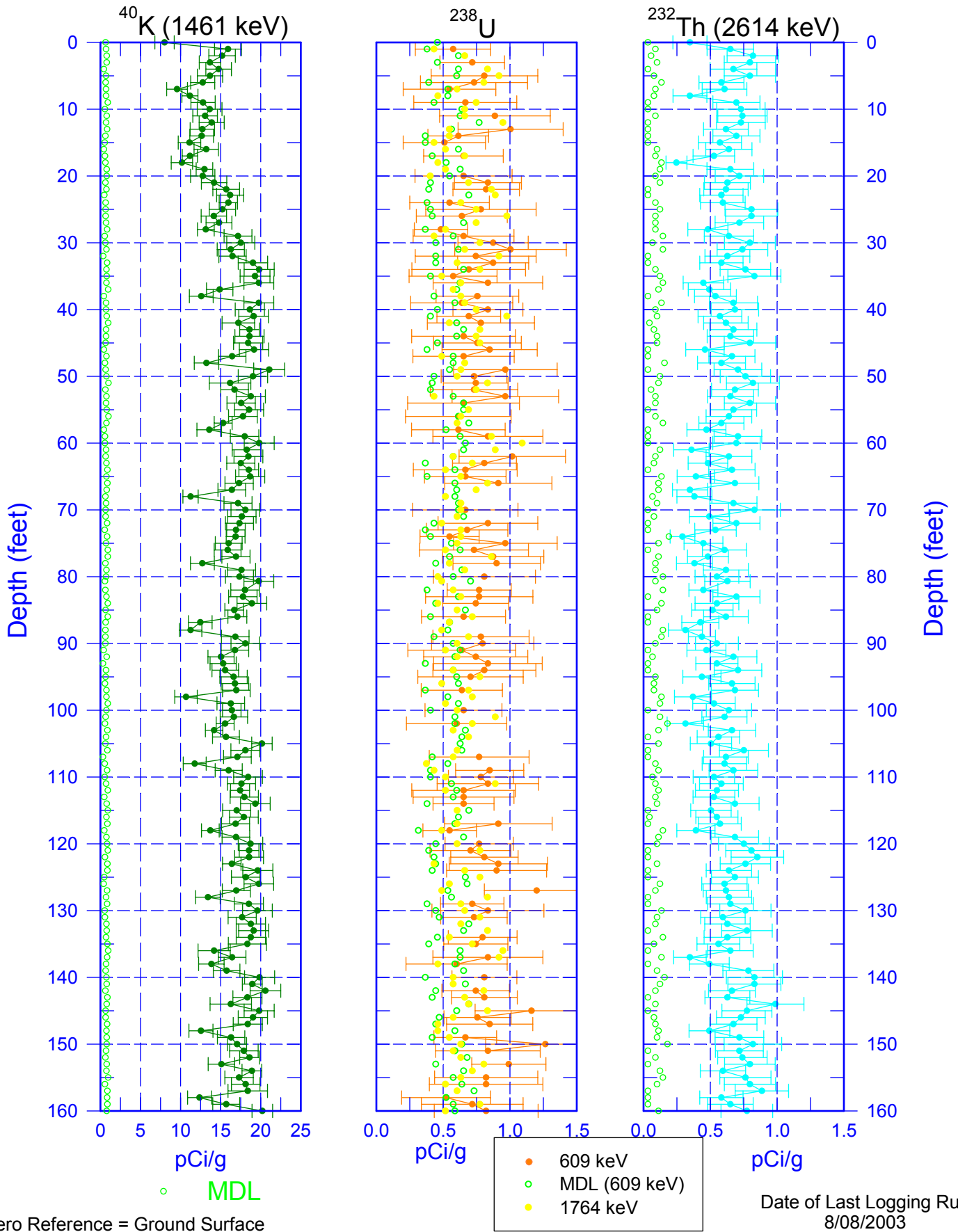


Zero Reference = Ground Surface

Date of Last Logging Run
8/08/2003

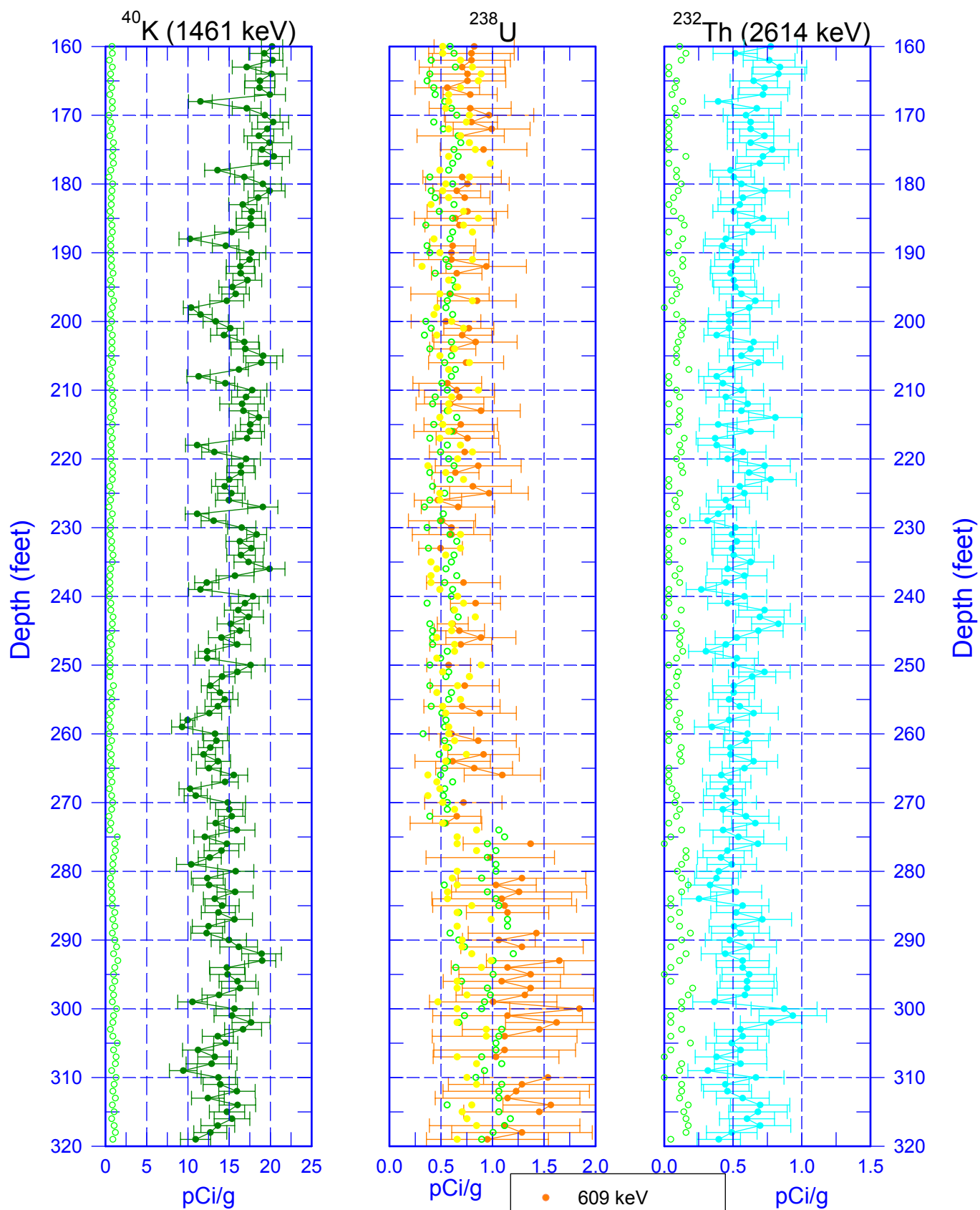
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Natural Gamma Logs



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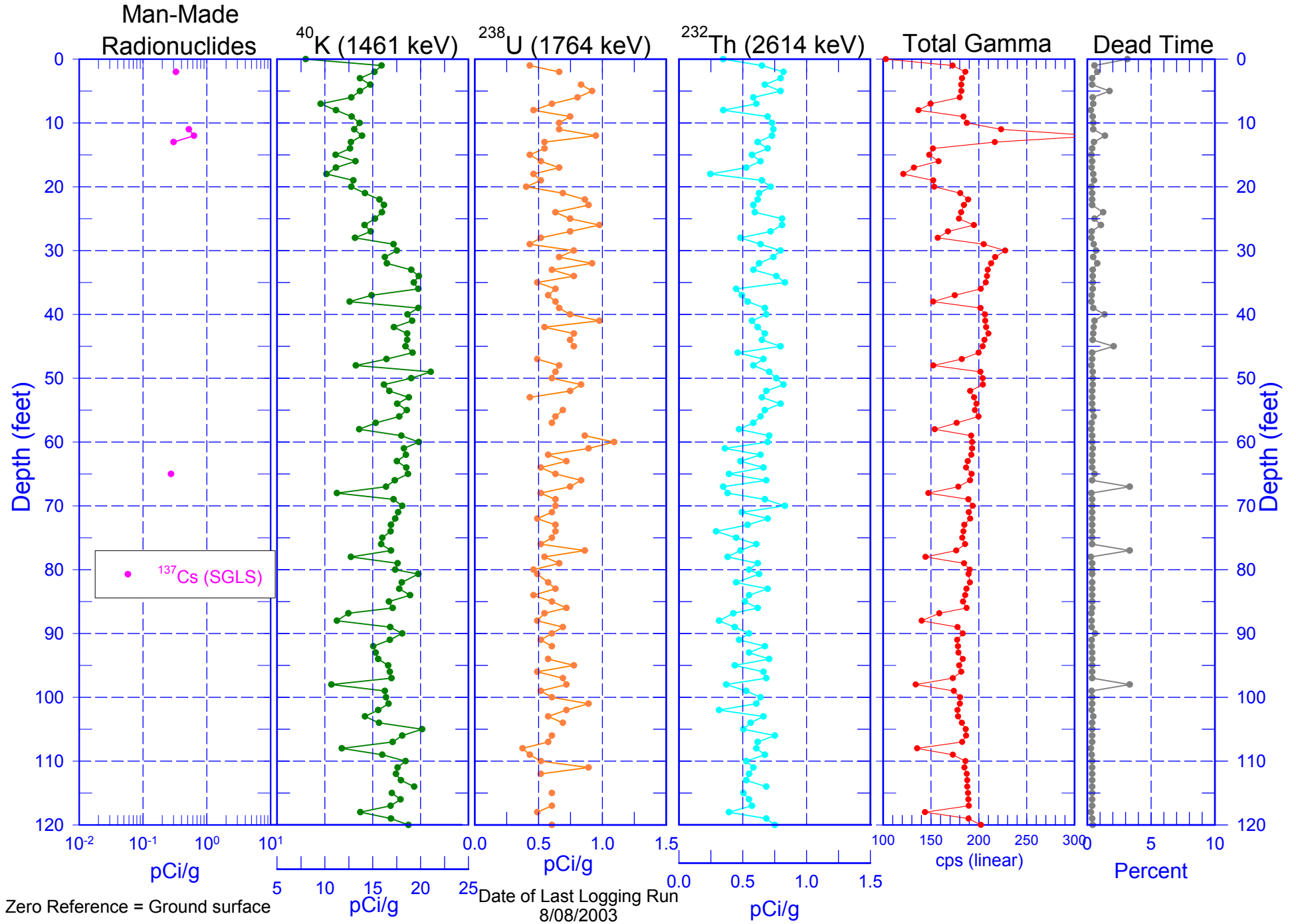
Natural Gamma Logs



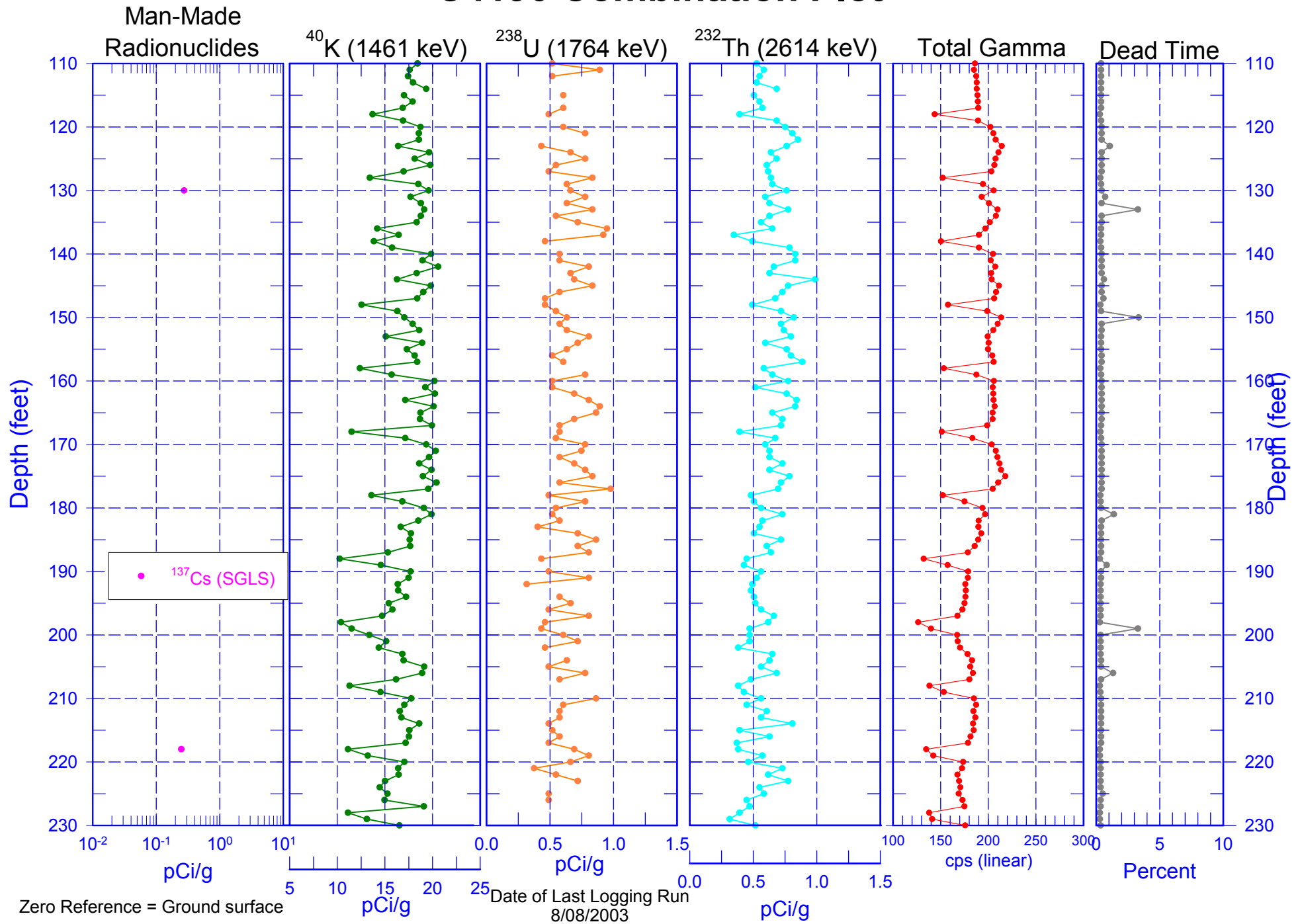
Zero Reference = Ground Surface

Date of Last Logging Run
8/08/2003

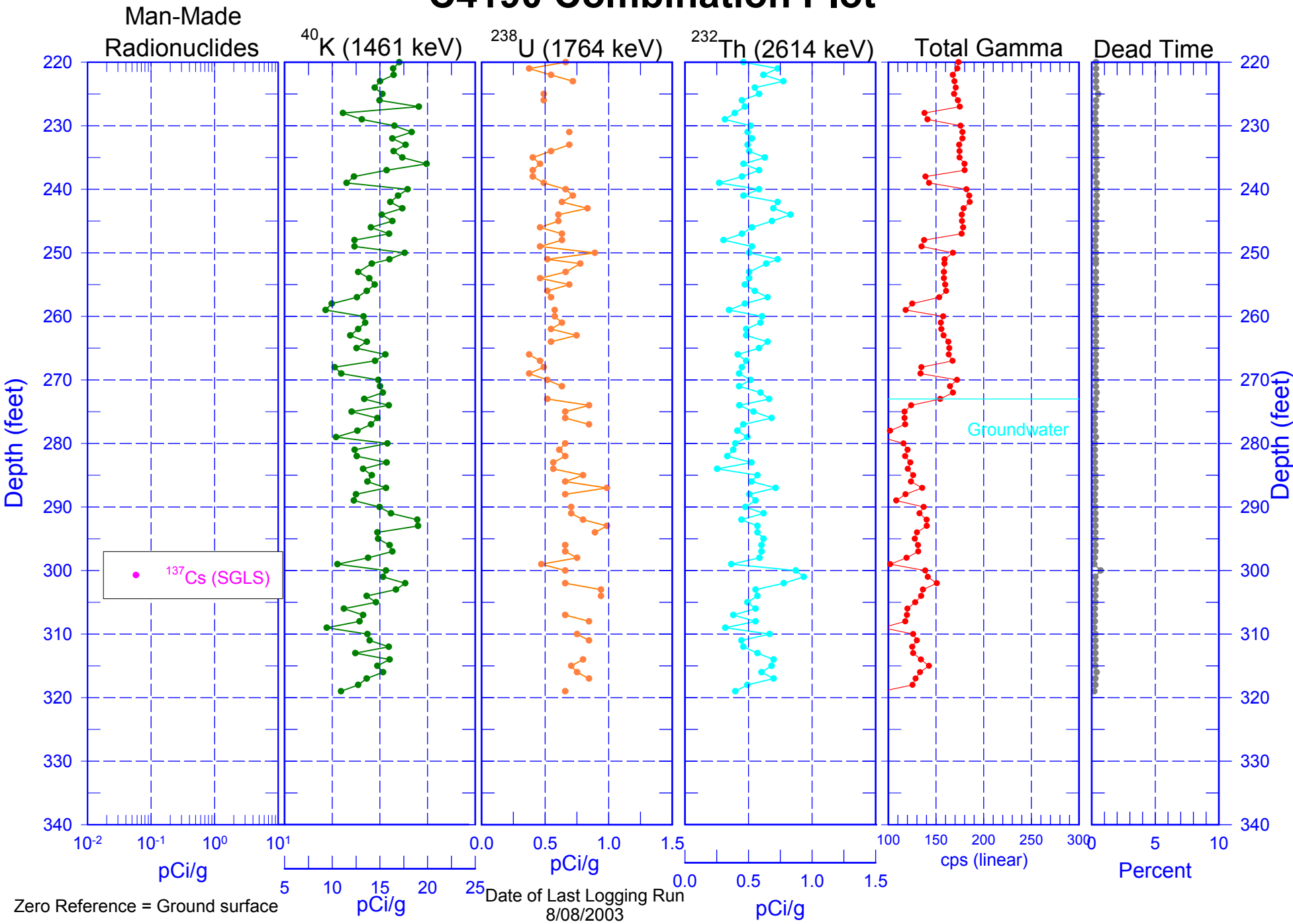
C4190 Combination Plot



C4190 Combination Plot

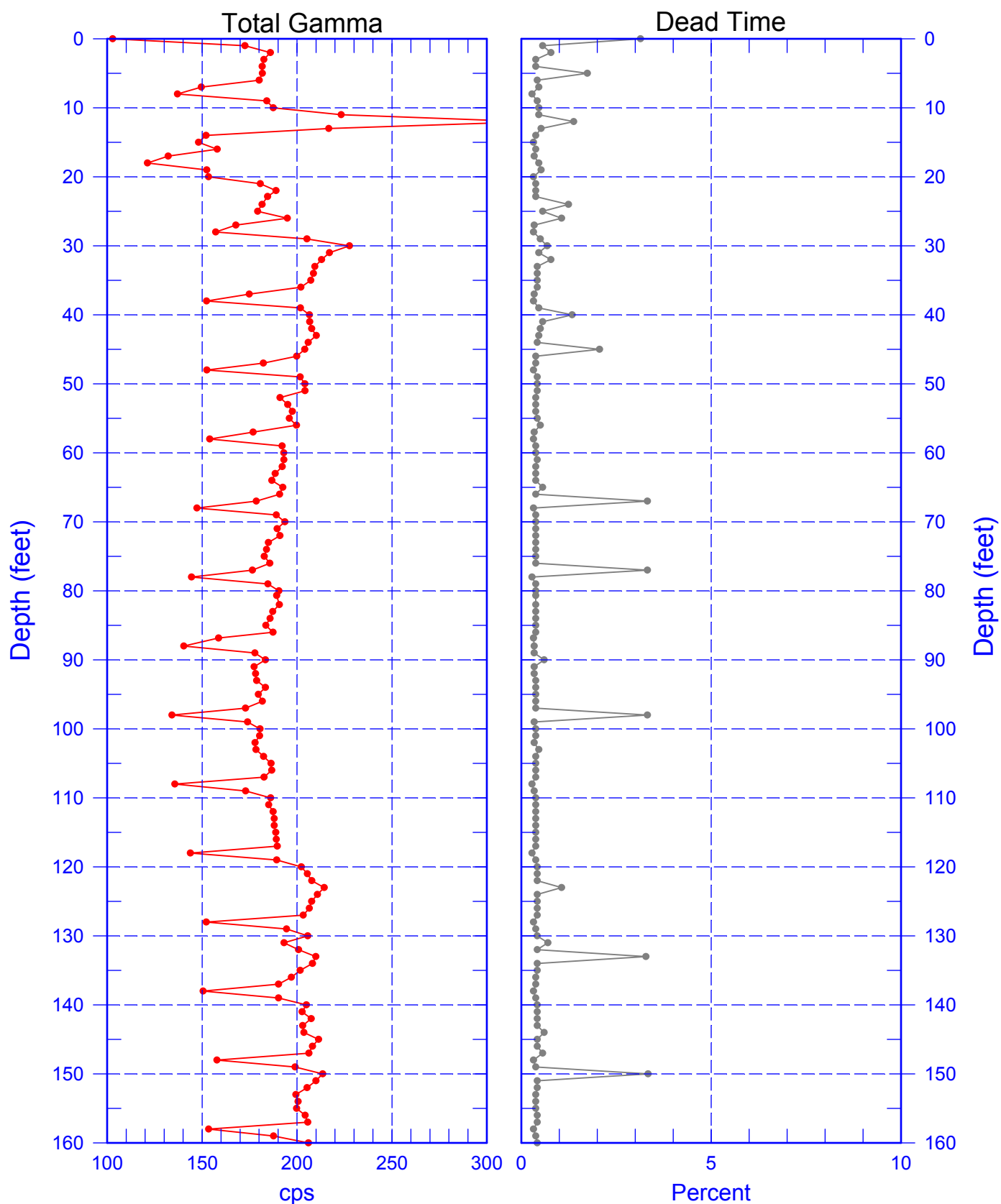


C4190 Combination Plot



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Total Gamma & Dead Time

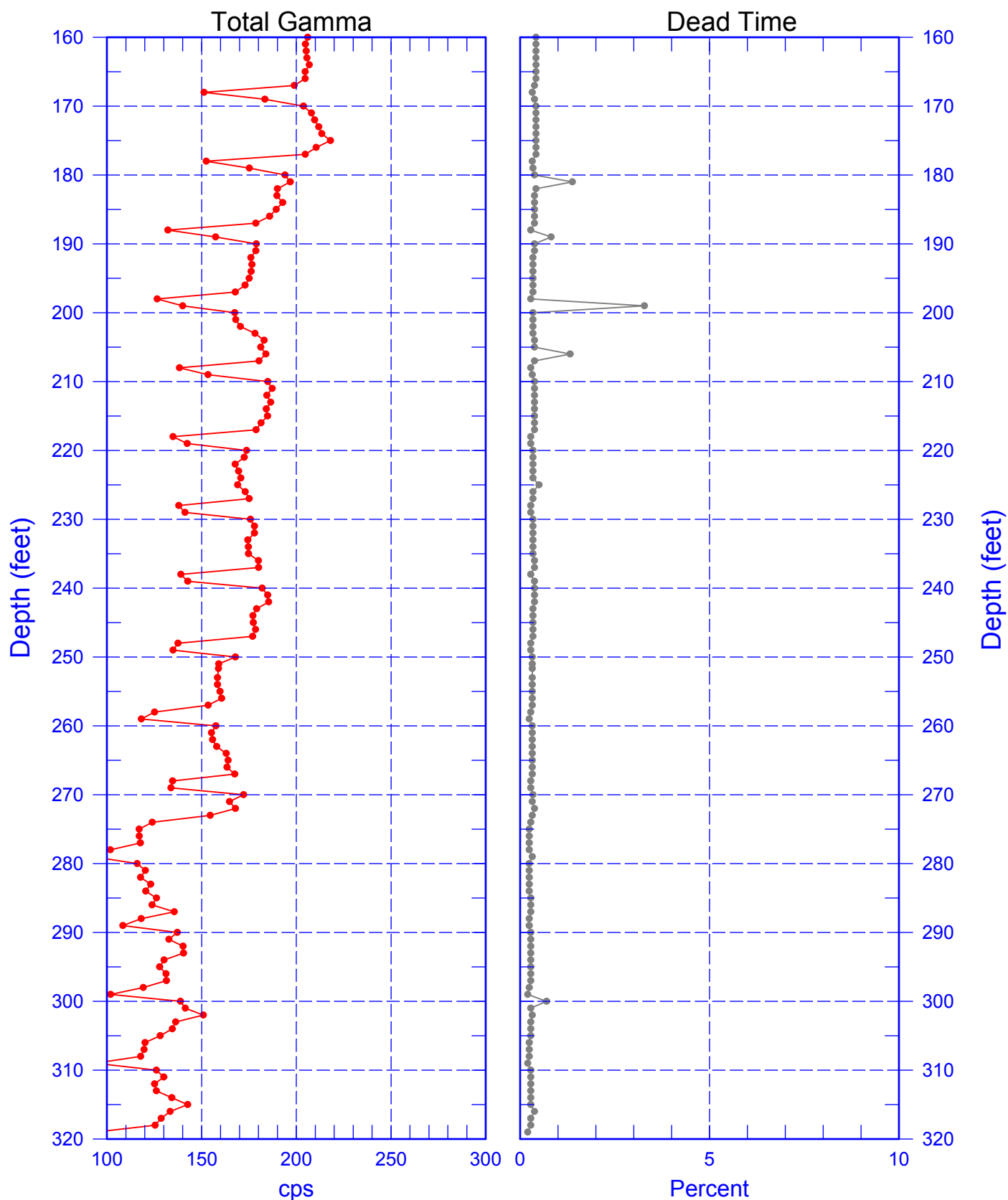


Zero Reference = Ground Surface

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Total Gamma & Dead Time

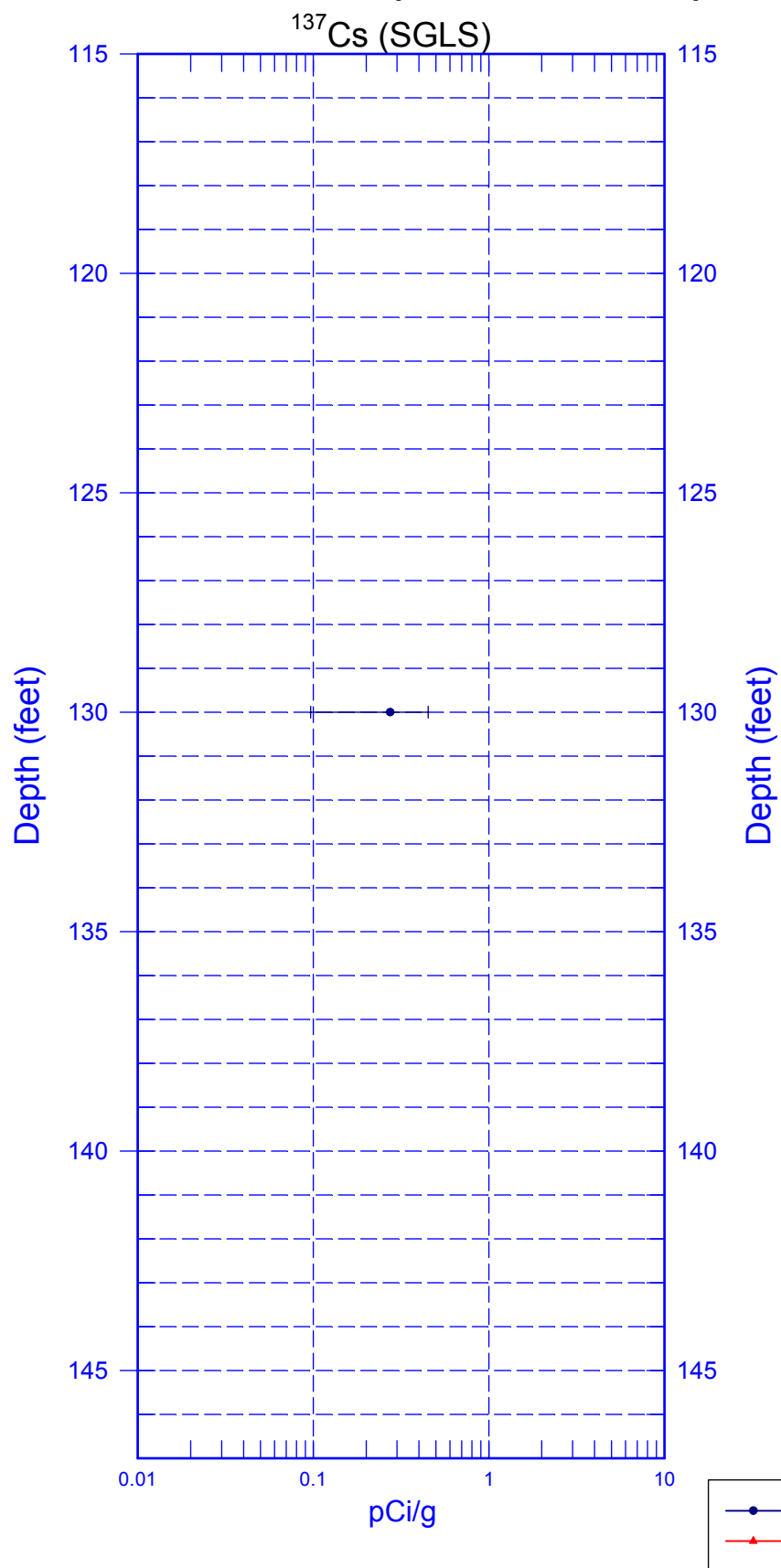


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Rerun of ^{137}Cs (147.0 to 115 ft)



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Rerun of Natural Gamma Logs (147.0 to 115.0 ft)

